

Microgrids for Commercial Buildings

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Outline

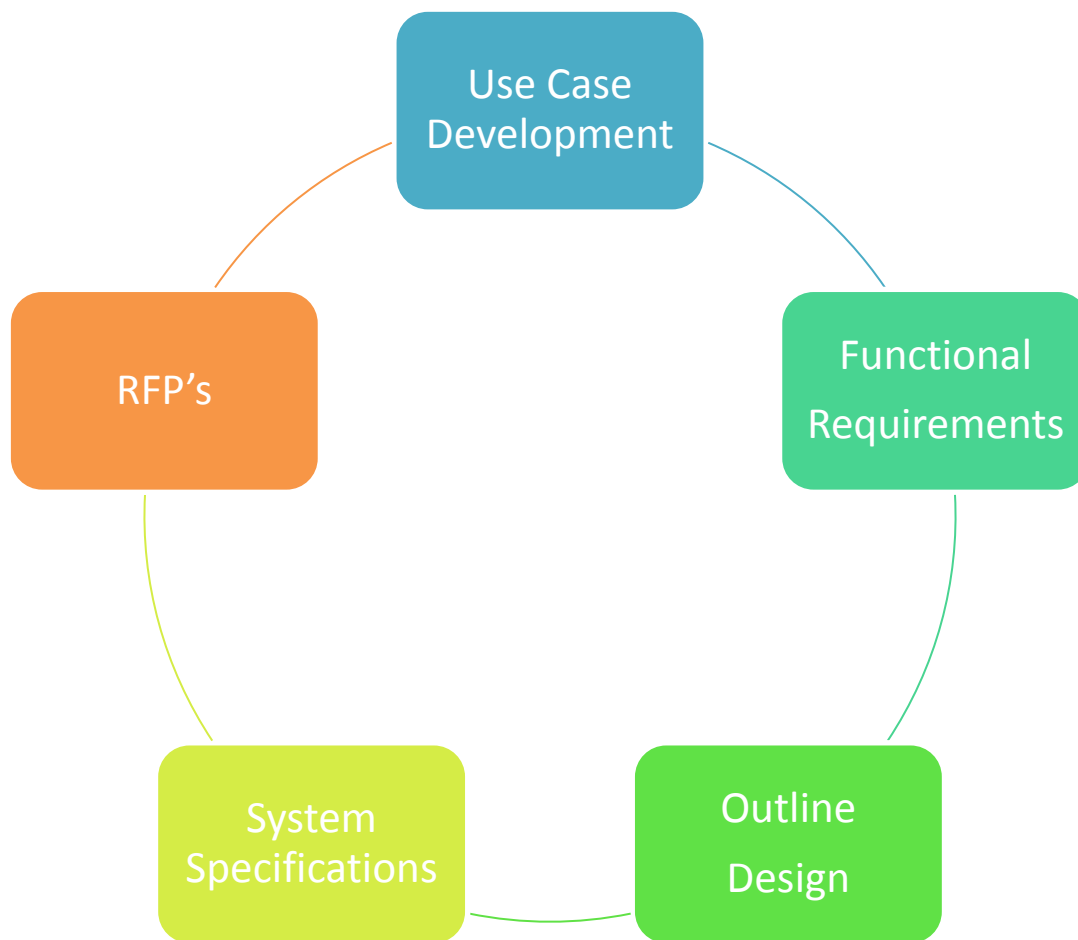
- Practical applications of Microgrids in commercial buildings to increase renewable generation contribution, and provide a high level of reliability and resiliency in response to grid outages.

3 Case Studies

- Microgrid designed for resilience
- Net Zero Energy Microgrid
- Community Microgrid



Common Design Process



Common Design Process



Common Design Process



Common Design Process



Common Design Process

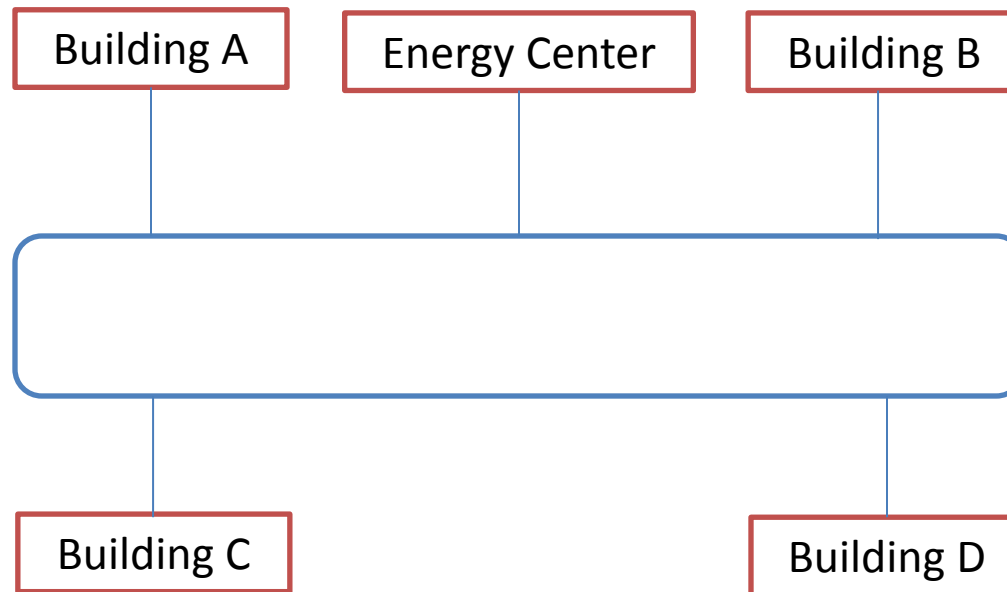


Case Study 1 - Resilience

- Key Use Case Outcomes
 - Maintain majority of building loads in a short outage
 - Maintain core building loads during an extended outage
 - Utilize renewable generation

Case Study 1 - Resilience

- Design Topology

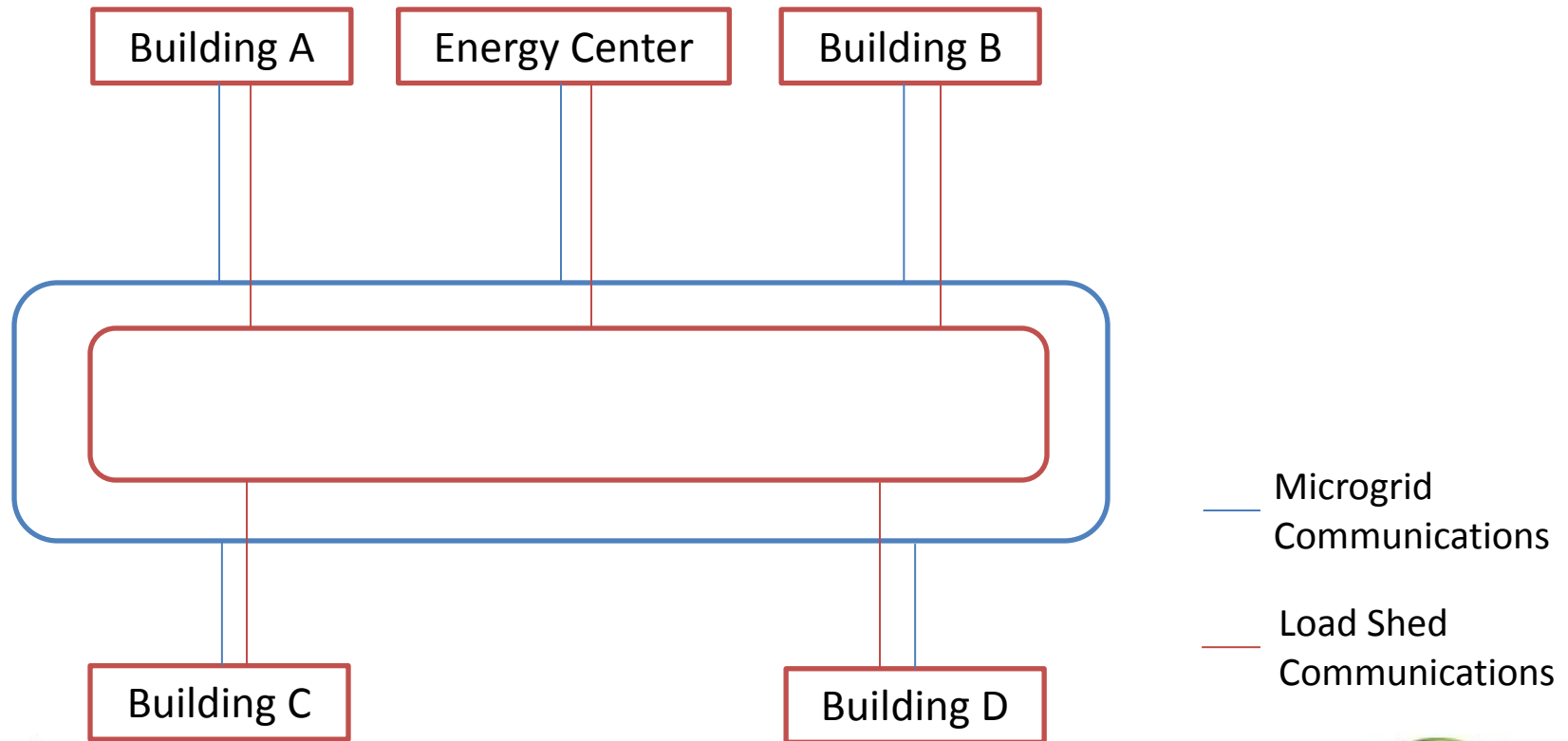


Case Study 1 - Resilience

- Modes of Operation
 - Loss of a Feeder
 - Load Shed Scheme
 - Matrix of generation / load scenarios
 - Utility Momentary Loss of Power
 - Utility Brown Out
 - Natural Gas Loss (Fuel Cells)
 - Utility Under-Frequency Event
 - Resynchronize to Utility

Case Study 1 - Resilience

- Reliable Load Shed

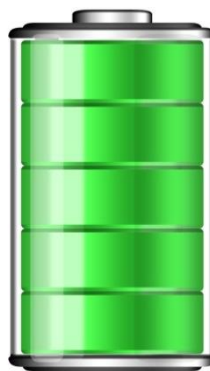
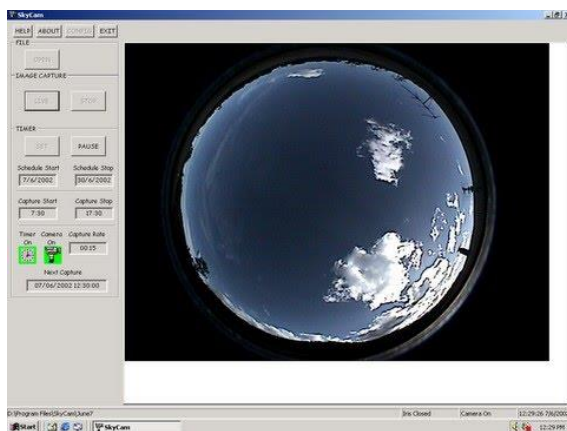


Case Study 2 - ZNE

- Key Use Case Outcomes
 - Generate majority of electricity on site
 - Participate in energy storage markets
 - Maintain majority of building loads in an outage
 - PV and Fuel cells to provide the majority of electricity in island mode

Case Study 2 - ZNE

- Design Challenges
 - High PV penetration
 - Mixed DER assets
 - Availability of products



Case Study 3 – Community

Scale x3

Resilience x2

Generation + Storage x12



Convention Center



Single Building



Community



5 hour Outage



72 hour Outage

1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

	Diesel Generator
	Photovoltaic (PV)
	Fuel Cell
	Lithium Ion Battery (Li-ion)
	Liquid Air Energy Storage (LAES)
	Flow Battery

Case Study 3 – Community

Generation Scenario	Storage Technology	5 Hour	72 Hour
Diesel Generator + PV	Li-ion	✓	X
	LAES	✓	X
	Flow Battery	✓	X
PV	Li-ion	X	X
	LAES	X	X
	Flow Battery	X	X
Fuel Cells + PV	Li-ion	✓	✓
	LAES	✓	✓
	Flow Battery	✓	✓
Diesel Generator + Fuel Cells + PV	Li-ion	✓	✓
	LAES	✓	✓
	Flow Battery	✓	✓

Building Microgrids

- Lessons Learnt
 - Use case process is key to success
 - Engage with vendors early
 - Cost v benefit assessment
 - Utility engagement
 - Right of way issues

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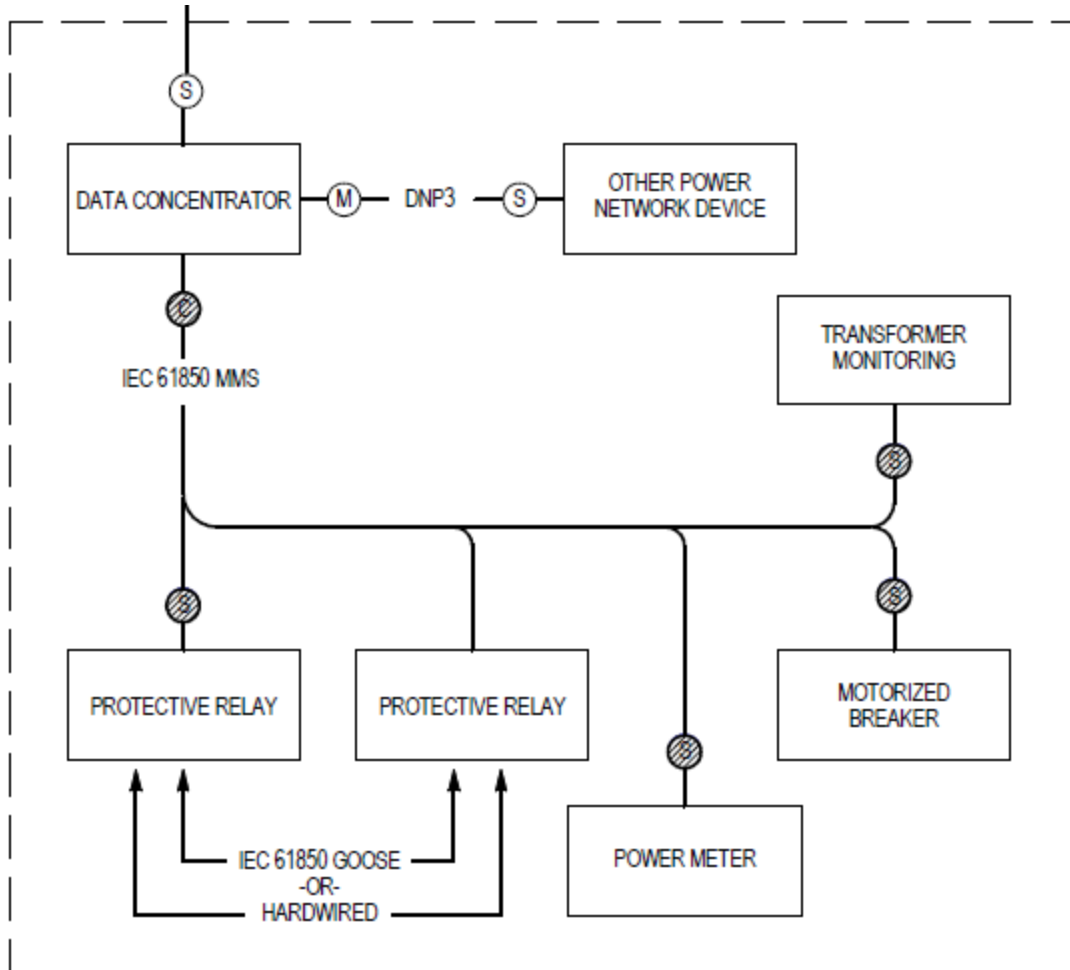
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Appendix



Appendix

